# A STUDY TO EVALUATE THE EFFECTIVENESS OF AUTOGENIC DRAINAGE AND POSTURAL DRAINAGE FOR IMPROVING PULMONARY FUNCTIONS IN PATIENTS WITH STABLE CHRONIC OBSTRUCTIVE PULMONARY DISEASES

DESSERTATION SUBMITTED TO

**THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY**

TOWARDS PARTIAL FULFILLMENT AS A REQUIREMENT FOR THE DEGREE

**MASTER OF PHYSIOTHERAPY**
**(PHYSIOTHERAPY IN CARDIO RESPIRATORY)**

**APRIL – 2016**

# A STUDY TO EVALUATE THE EFFECTIVENESS OF AUTOGENIC DRAINAGE AND POSTURAL DRAINAGE ON PULMONARY FUNCTIONS IN PATIENTS WITH STABLE CHRONIC OBSTRUCTIVE PULMONARY DISEASES

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**Internal Examiner:**

**External Examiner:**

**A dissertation submitted in partial fulfillment as a requirement for the degree**

**MASTER OF PHYSIOTHERAPY**

To

**THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY**

**CHENNAI**

**APRIL 2016**

# CERTIFICATE

This is to certify that the research work entitled **"A STUDY TO EVALUATE THE EFFECTIVENESS OF AUTOGENIC DRAINAGE AND POSTURAL DRAINAGE ON PULMONARY FUNCTIONS IN PATIENTS WITH STABLE CHRONIC OBSTRUCTIVE PULMONARY DISEASES"** was carried out by the candidate with the **(REG NO: 271430141)** Master of physiotherapy student at Thanthai Roever Collage of Physiotherapy, Perambalur, submitted to Tamil Nadu Dr. M.G.R. Medical University, Chennai towards the partial fulfillment as a requirement for the Degree Master of Physiotherapy (MPT- CARDIO RESPIRATORY).

**Prof. C.V. John Franklin, MPT., MIAP.,**
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Perambalur -621212

**PLACE:**

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**GUIDE: Prof. Muruganandam M.P.T (Cardio Respiratory)**

Thanthai Roever College of Physiotherapy

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**PLACE**:

**DATE**:

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# INTRODUCTION

Chronic Obstructive Pulmonary Disorder is a slow progressive disorder of the airways that is characterized by gradual loss of lung function. This results in lung destruction due to chronic mucus impartion and infection of airway. Clearance of this mucus is an important part of therapy in COPD but is complicated by impaired mucociliary clearance. The term COPD includes chronic bronchitis, chronic Obstructive bronchitis, emphysema or combinations of these conditions, as per National Heart Lung and Blood Institute, represents the fourth leading cause of death in the world.[1]

The pathological changes that occur over time in COPD are inflammation of the mucus membranes of the airways; decreased production and retention of mucus; narrowing and destruction of airways and bronchial walls. These structural changes are reflected in pulmonary function tests. Much physical impairment develops over time. Patients typically have a chronic, productive cough and are often short of breath. There is inability to remove air from the lungs which in turn affects the ability of the respiratory system to transport oxygen into the lungs. Consequently, functional limitations and eventually disability occur consistent with the disablement process. Impairments such as decreased vital capacity and forced expiratory volume are associated with decreased tolerance to exercise, frequent episodes of dysponea, decreased walking speed and distance and eventually inability to perform activities of daily living at home or in the work place or to remain an active participation in the community.[2]

The purpose of this study was to determine the effectiveness of postural drainage and Autogenic Drainage on pulmonary function by mucus clearance techniques, because mucus clearance is a problem in COPD and Autogenic Drainage and Postural Drainage is a traditional method of facilitating mucus clearance. Research studies with COPD patients support the efficacy of Autogenic Drainage and Postural Drainage in patients who can tolerate it. Both these techniques promote independence and self-care in the patients and effectiveness of both has been supported by the researches.

Conventional therapy involves enhanced mucus clearance with Autogenic Drainage and Postural Drainage. Autogenic Drainage is an airway clearance that allows patients to do their own therapy. This provides more independence and control over daily care when compared with Postural Drainage. Autogenic Drainage was devised by the Belgian physiotherapists Jean chevalier. It was first developed in 1960's to treat Asthmatic patients. It is now being used widespread to treat patients with retention of secretions.[3]

Autogenic Drainage uses diaphragmatic breathing to mobilize secretions by varying expiratory airflow. It consists of these phases:

a. Breathing at low lung volumes to 'unstick' the peripheral secretions.
b. Breathing at low – to – mid lung volume (tidal volume) to 'collect' mucus in the middle airways.
c. Breathing at mid – to – high lung volumes to 'evacuate' the mucus from the central airways.[4]

Postural Drainage is a component of bronchial hygiene therapy. It is accomplished by positioning the patient so that position of the lung segment to be drained allows gravity to have its greatest effect. The length of the time spent in each position and total treatment time will depend on the gravity of secretion in each area and the number of areas that have to be drained. It may be necessary to spend an average of 15 – 20 minutes in each position to allow adequate drainage and this may mean that different areas will require draining at alternate treatments. The worst areas would be drained first.[4] Both of these techniques are used to improve forced vital capacity (FVC) and forced expiratory volume in one second ($FEV_1$) which is analyzed by computerized spirometer. Spirometry is the pulmonary function test done to measure how much and how quickly you can move air out of your lungs. The test reveals the capacity of air it can hold, speed of breathing and ability to exchange gases from blood. The test can diagnose lung disease and measure the severity of lung problems.

So, the importance of doing this study is that as we have come to know that COPD is characterized by a reduction in airflow and an increase in dead space & chronic cough and sputum production are common features of COPD and have significant impact on exacerbation frequency and quality of life. So, to increase Tidal Volume, decrease Respiratory Rate & sense of dysponea, postural drainage and autogenic drainage has been used for improving the quality of life and leading an independent life for the patient suffering from COPD.

# NEED FOR THE STUDY

To identify an effective technique for airway clearance and to improve pulmonary function. Because some studies says autogenic drainage is the one best for clear the secretion and other some says postural drainage is best.

# HYPOTHESIS

**Null hypothesis**

There is no significant difference between autogenic drainage and postural drainage in stable COPD patients.

**Alternate hypothesis**

There is significant difference between autogenic drainage and postural drainage in stable COPD patients.

# AIM & OBJECTIVES

## AIM:

To identify an effective technique for airway clearance and to improve pulmonary function.

## OBJECTIVES:

1. To compare the pulmonary function tests between the Autogenic Drainage and Postural Drainage.

2. To find out the effectiveness of Autogenic Drainage and Postural Drainage in airway clearance.

# REVIEW OF LITERATURE

**Holland AE et al., (2006)** in his study quoted that chronic cough and sputum production are common features of chronic obstructive pulmonary disease. So, analysis of short – term studies suggested that there may be benefit from autogenic drainage which has proved positive result in clearance of sputum.[7]

**Pryor et al (2004)** quoted that physical therapy techniques can be used to augment mucociliary clearance, for example the ACBT, autogenic drainage, positive expiratory pressure and there is a benefit from physical therapy for people with obstructive airway disease.[10]

**Opdekamp C et al., (2003)** quoted that due to reduction in airflow and an increase in dead space in COPD patients. Postural drainage in most parts of the world has been used for airway clearance which also includes forced expiratory maneuvers or techniques of breathing at different airflow and lung volumes.[8]

**Savei S et al., (2000)** in his study stated that Autogenic drainage has improved forced vital capacity, force expiratory volume in 1 second, peak expiratory flow rate, forced expiratory volume from 25 to 75% an concluded it by stating that Autogenic drainage is as effective as the ACBT in clearing secretions and improving lung functions.[5]

**Langenderfer B (1998)** in his study stated that percussion and postural drainage promotes independence and self care in the patients and these 2 techniques are the traditional method of facilitating mucus clearance.[6]

**Donald R Giles (1995)** in his study suggested that autogenic drainage and postural drainage has short term benefits in patients with cystic fibrosis but in pulmonary function test autogenic drainage is superior to postural drainage as a secretion clearance technique.[9]

**Olseni et al (1994)** stated that 2 techniques, postural drainage and positive expiratory pressure breathing, were used. Both techniques were given with the combination of forced expiratory techniques. The outcome was the clearance of mucus was more effectively done by postural drainage combined with forced expiratory techniques.[11]

**Mortensen J et al., (1991)** studied the effect of two chest physiotherapy regimens on whole lung and regional tracheobronchial clearance in 10 patients with cystic fibrosis. The regimen were given on 2 separate days and consisted of 20 min of (1) Postural drainage and the forced expiratory technique (PD + FET), and (2) Positive expiratory pressure (PEP – mask) and FET (PEP + FET). A third day served as control and he concluded that PD has short term whole lung and regional TBC in patients with cystic fibrosis.[12]

**Maloney FP et al., (1981)** determined the effect of PD on pulmonary functions and sputum volume in patients with partially reversible chronic obstructive pulmonary disease; comparisons were made between days with and without PD in 13 patients. Pulmonary function tests were done 3 times a day over 12 – day period. Outcome was PD showed effect in some patients.[13]

# DESIGN AND METHODOLOGY

## STUDY DESIGN:

Quasi Experimental Study Design

## STUDY SETTING:

Hospital approved by the guide and college.

## SAMPLING:

Purposive Random Sampling.

40 patients who were diagnosed for COPD were selected and divided into 2 groups alternatively after taking written consent to participate in the study. Participants in group 'A' received Autogenic Drainage and participants in Group 'B' received Postural Drainage by the same investigator twice a day for 10 days continuously.

## INCLUSION CRITERIA:

1. Male patients diagnosed as COPD.
2. Age group between 30 – 50 years.
3. Capable to follow verbal & written commands.

## EXCLUSION CRITERIA:

1. Restrictive lung disease (Lung abscess, Tuberculosis).
2. Patients having any site of active infection (e.g. Tuberculosis, Lung abscess), Emphyema.
3. Thoracic surgery
4. Patients who have taken any prior physiotherapy treatment for respiratory problems.
5. Multiple respiratory & cardiac disorders.
6. Emphysematous cavity.
7. Recent Head injury
8. Resting BP below 110/70 or above 130/80.

## MATERIALS USED:

1. Computerized Spirometer
2. Postural Drainage Couch.
3. Stop Clock.
4. Recording Sheet.

## PROCEDURE

### TECHNIQUES OF SECRETION REMOVAL:

Each patient was explained well about the procedure to be done and its effects following which autogenic drainage and postural drainage were given to group A and group B respectively.

Prior to beginning with the treatment session for both groups, pulmonary function tests were performed to determine the values of

- Forced Vital Capacity (FVC).
- Forced Expiratory Volume in one second (FEV1).
- Ratio of Forced Expiratory Volume in one second and Forced Vital Capacity (FEV1/FVC).
- Inspiratory Reserve Volume (IRV).
- Expiratory Reserve Volume (ERV).
- Tidal Volume (TV).

for each patient were recorded.

**AUTOGENIC DRAINAGE:**

Patients of Group A were given autogenic drainage which comprise of 3 phases, which can be explained as follows –

***PHASE I: (Unsticking Phase)***

Patients were asked to inspire which was followed by a deep expiration into ERV as much as possible contracting the abdominal muscles to achieve this. This low lung volume breathing was continued until the mucous loosened and started moving to the larger airways.

***PHASE II: (Collecting Phase)***

Patients were asked to perform a inspiration which was held for 1 – 3 seconds followed by expiration. This low to mid – lung volume

breathing was continued until the sound of mucous decrease indicating its movement into the central airways.

***PHASE III: (Evacuating Phase)***

Patient was asked to perform a long inspiration into the IRV range holding it for 1 – 3 seconds and then expiring. This was continued until the secretions moved into the trachea and was ready to be expectorated. The collected mucous was then evacuated by a stronger expiration or a high volume huff.

In all of the above phases, inhalation was done slowly and through nose if possible using the diaphragm and lower chest. The 2 – 3 second hold which followed inspiration was included to allow collateral ventilation to get air behind the secretion. Exhalation was asked to be performed through the mouth, through open glottis so that the secretion could be heard. Each level requiring about an average of 2 – 3 minutes with a full cycle being completed in about 6 – 10 minutes. Coughing was avoided in Phase I & Phase II.

During this procedure it was ensured that all patients develop a personal technique based on their own capability and state of health.

**POSTURAL DRAINAGE:**

Patients in Group B were given postural drainage which involved positioning the patient in a way so that gravity assists the drainage of the affected lung segments.

Each patient was auscultated following which they were placed in the appropriate position using pillows or bed rolls as needed to drain the affected lung segment or lobe. These positions were maintained for 20 – 30 minutes.

The tables and diagrams below show the position the patient had to be placed in to drain the respective lung segment.

**UPPER LOBE:**

- Apical Segments (Rt)
    - Patient seated upright.

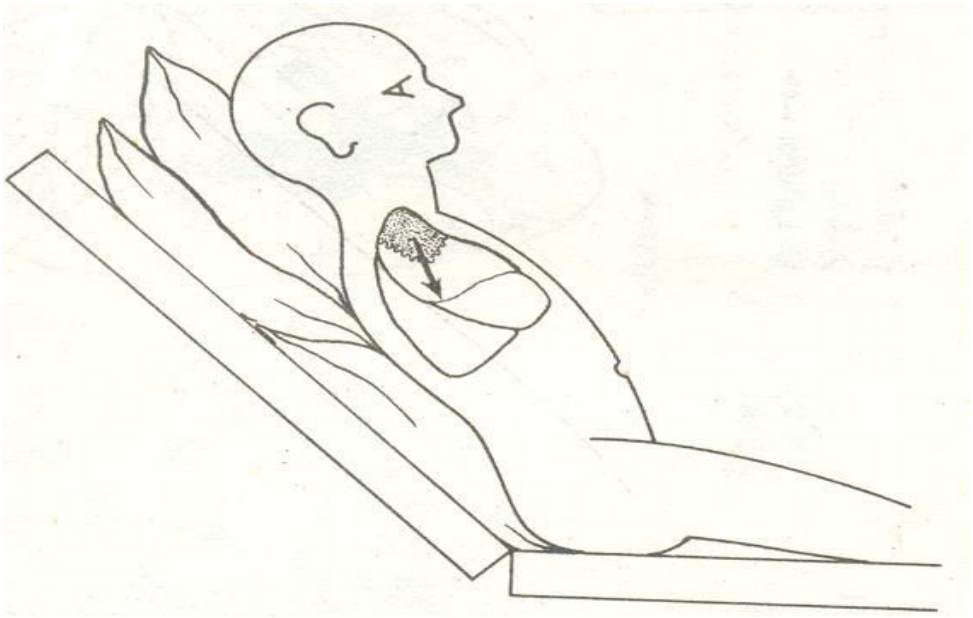


**Fig. 4.1**

- Posterior segment (Rt)
    - Patient should lie on left side then turn $45^0$ on to his face resting against a pillow with other supporting his head.

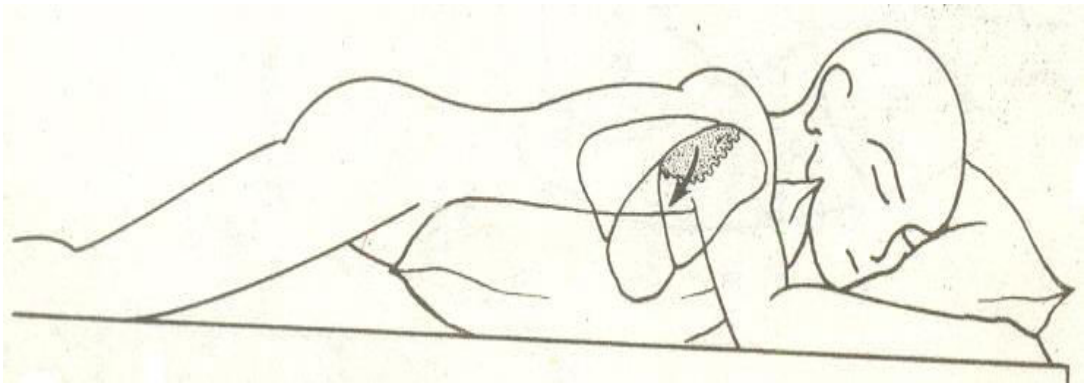


**Fig. 4.2**

- Posterior segment (Lt)

    - Patient should lie on his right side then turn $45^0$ on to his face with 3 pillows arranged to raise the shoulder 30 cm from bed.

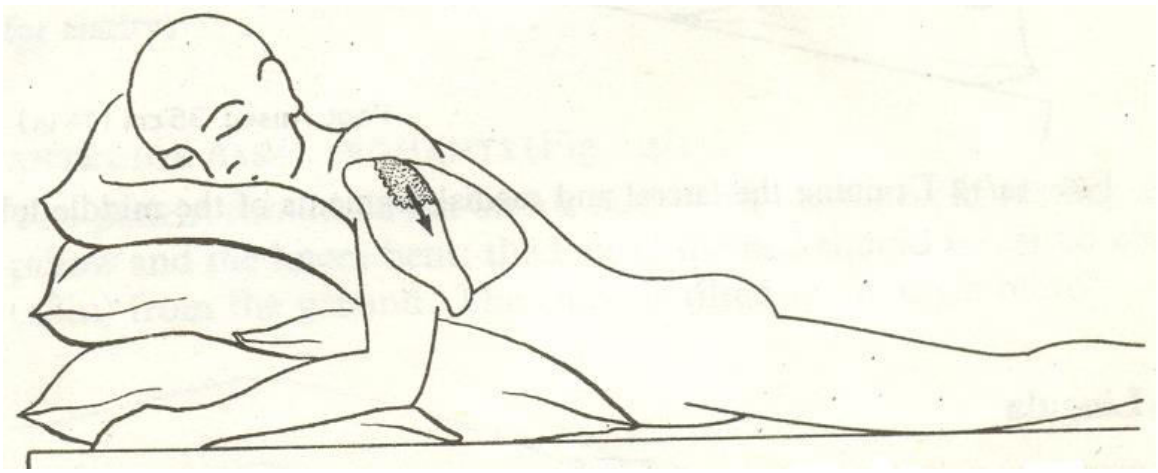


**Fig. 4.3**

- Anterior segment (Rt & Lt)

    - Patient should lie flat on his back with arms by his side and knee is flexed over pillow.

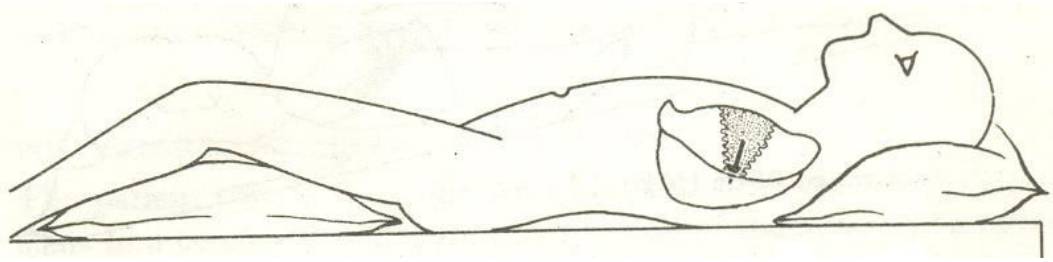


**Fig. 4.4**

**MIDDLE LOBE:**

- Right lung : Lateral & Medial Segment:
    - Patient lie on his back with body quarter turn to the left with pillows below right side from shoulder to hip and foot end of bed raised 14” from ground.

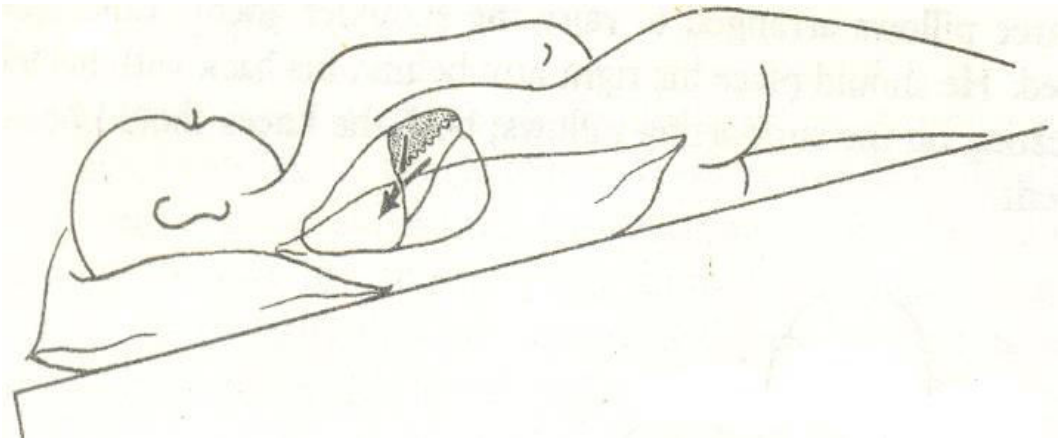


**Fig. 4.5**

- Left Lung: Superior & Inferior Segment:
    - Patient lie on his back with body quarter turn to right with pillows below. Left side from shoulder to hip and foot end of bed raise 14” from ground.

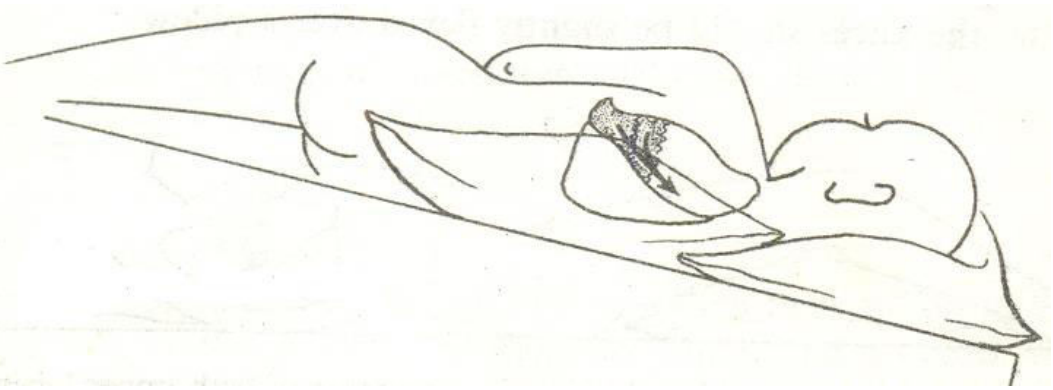


**Fig. 4.6**

**LOWER LOBE:**

- Apical segment (Rt & Lt):
    - Patient lying prone with head turned to one side.

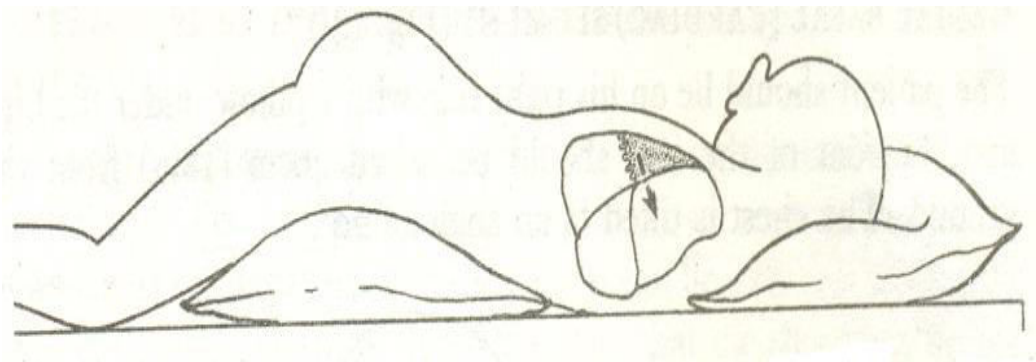


**Fig. 4.7**

- Anterior basal Segment (Rt & Lt):

    - Patient lying flat on his back with buttock resting on a pillow and knees bend, foot end of bed raised 18” from the ground.

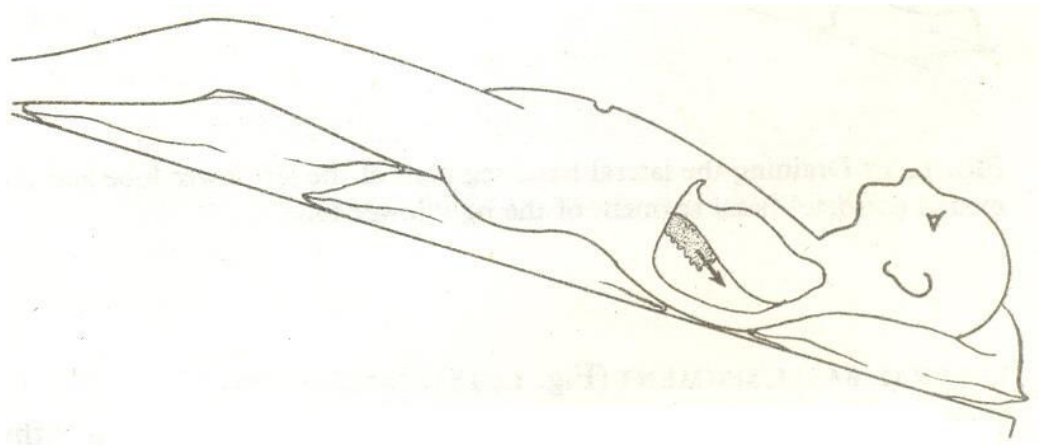


**Fig. 4.8**

- Posterior Segment (Rt & Lt):

    - Patient lying prone with pillow under hips. Foot end of bed raised 18” from ground.

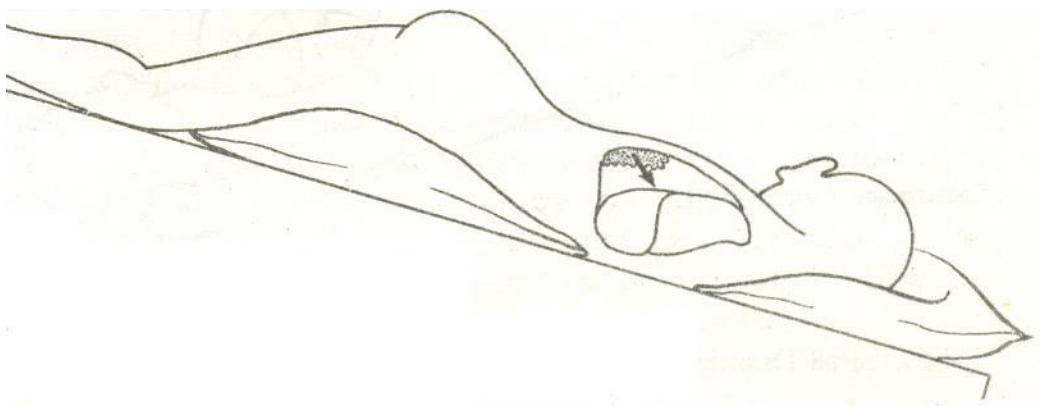


**Fig. 4.9**

- Medial basal segment (Rt):

    - Patient lying on the right side. Foot end of bed raised 18” from the ground.

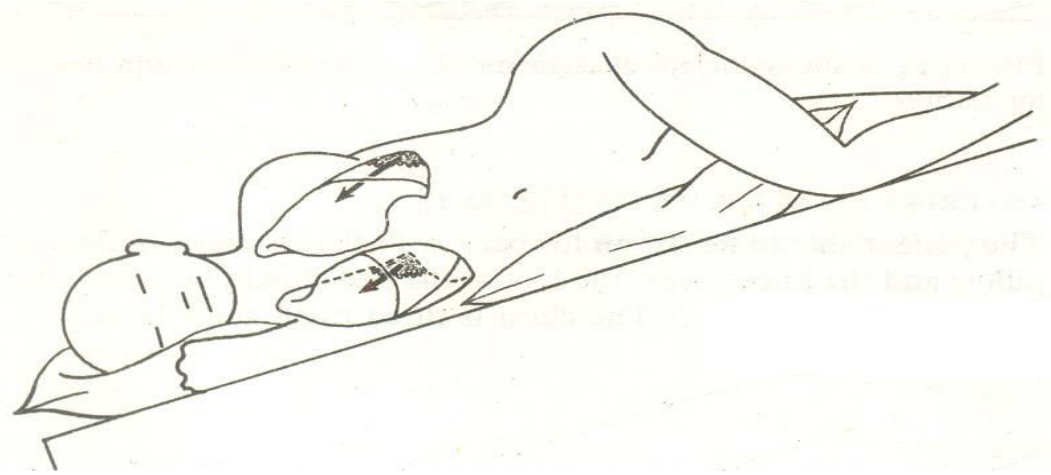


**Fig. 4.10**

- Lateral basal segment (Rt & Lt):

    - Patients should lie on the opposite side to be drained with foot end of the bed raised 18” from the ground.[4]

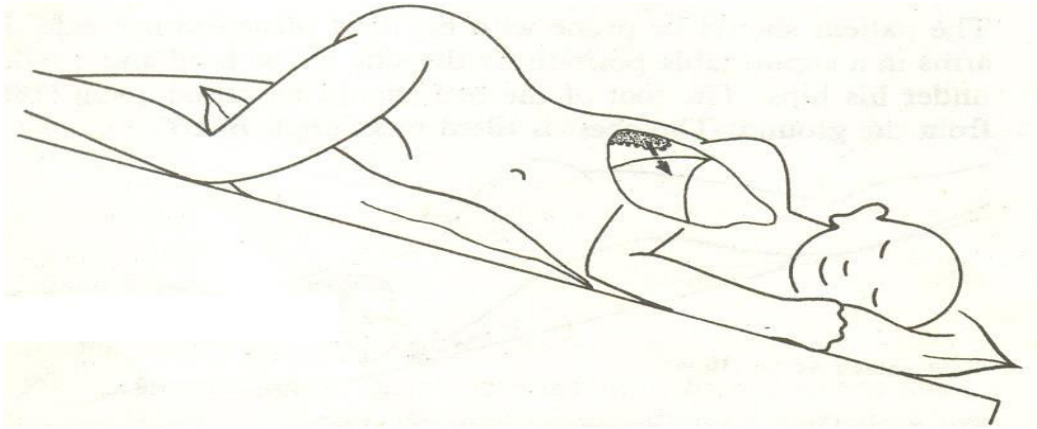


**Fig. 4.11**

Patients of both groups were given their respective treatment for 10 days twice a day and at the end of 10 days PFT was repeated and parameters were recorded for evaluation.

## PULMONARY FUNCTION TESTS (PFT):

PFT determines the work capacity of the lungs. The test reveals the capacity of air it can hold, speed of breathing and ability to exchange gases from blood. The test can diagnose lung diseases and measure the severity of lung problems.

Spirometer measures the speed of air that can move in and out of the lungs. For this test breathing is done through a mouth piece attached to a recording device (spirometer). The information collected will be printed out on a chart called a spirogram.

Lung function tests are done to

- Determine the cause of breathing problems.
- Diagnose certain lung diseases, such as COPD, restrictive diseases.
- Evaluate a person's lung function before surgery.
- Monitor the effectiveness of treatment for lung diseases.[14]

The common lung function values measured with Spirometry are

- Forced Vital Capacity (FVC):
    - Forcefully exhaled after a deep inhalation.
    - VC = 4700 ml (4.7 lit)
- Inspiratory Reserve Volume (IRV):
    - Volume of air inspired forcefully beyond TV.
    - IRV = 3000 ml (3 lit)
- Tidal Volume (TV):
    - Volume of air breathed in a single normal quiet respiration
    - TV = 500 ml (0.5 lit)
- Expiratory Reserve Volume (ERV):
    - Volume of air expired forcefully after normal expiration
    - ERV = 1200 ml (1.2 lit)
- Force Expiratory Volume (FEV):
    - Volume of air expired forcefully in a given unit of time (after a deep inspiration)
- $FEV_1$:
    - Amount of air expired forcefully in 1 sec.
    - $FEV_1$ = 75% of total VC.[15]

**Table 4.1: Variations of PFT values in COPD**

| **Lung Function Test**[14] | **Result as predicted for age, height, weight.** |
|---|---|
| Forced Vital Capacity (FVC) | Normal or lower than predicted value |
| Forced Expiratory Volume ($FEV_1$) | Lower with higher $FEV_2$ and $FEV_3$ |
| FEV1 divided by FVC | Lower |
| Forced Expiratory flow 25% to 75% | Lower |
| Peak Expiratory flow (PEF) | Lower |
| Maximum voluntary ventilation (MVV) | Lower |
| Slow Vital Capacity (SVC) | Normal or Lower |
| Total Lung Capacity (TLC) ($V_T$) | Normal or higher |
| Functional residual capacity (FRC) | Higher |
| Residual Volume (RV) | Higher |
| Expiratory Reserve Volume (ERV) | Normal or Lower |
| RV divided by TLC ratio | Higher |

In COPD, when patients perform a VC maneuver, it can either be slow or fast. During exhalation, the amount of air exhaled over time can be measured. In a slow VC a patient with COPD can take a great

deal of time to empty his lungs. In a FVC a normal individual can exhale 75% of the VC in 1st sec of exhaled (FEV1). Patients with COPD often have a greatly decreased VCs. Only 40% of which are predicted. A decreased in VC occurs as a result of absolute reduction in distensible lung tissue.[16]

**Table 4.2: Variations of PFT values in Restrictive Lung Diseases**

| **Lung Function Test[14]** | **Result as predicted for age, height, weight.** |
|---|---|
| Forced Vital Capacity (FVC) | Lower than predicted value |
| Forced Expiratory Volume ($FEV_1$) | Normal or lower with higher $FEV_2$ and $FEV_3$ |
| FEV1 divided by FVC | Normal or higher |
| Forced Expiratory flow 25% to 75% | Normal or Lower |
| Peak Expiratory flow (PEF) | Normal or higher |
| Maximum voluntary ventilation (MVV) | Normal or Lower |
| Slow Vital Capacity (SVC) | Lower |
| Total Lung Capacity (TLC) ($V_T$) | Lower |
| Functional residual capacity (FRC) | Normal or Higher |
| Residual Volume (RV) | Normal or Higher |
| Expiratory Reserve Volume (ERV) | Normal or Lower |
| RV divided by TLC ratio | Normal or Higher |

In Restrictive lung conditions, there is a loss of lung tissue, a decrease in the lung's ability to expand, or a decrease in the lung's ability to transfer oxygen to the blood or carbon dioxide out of the blood. Restrictive lung disease can be caused by conditions such as pneumonia, lung cancer, scleroderma, pulmonary fibrosis, sarcodosis or multiple sclerosis. Other restrictive conditions include some chest injuries, being very overweight (Obesity), pregnancy, and loss of lung tissue due to surgery.[14]

**PICTURE 4.13:**

**PATIENT PERFORMING AUTOGENIC DRAINAGE**

## Picture: 4.14

**PATIENT PERFORMING PFT TEST**

**PATIENT PERFORMING PFT TEST**

**PICTURE: 4.15**

**PATIENT PERFORMING POSTURAL DRAINAGE**

# DATA ANALYSIS

The collected data were tabulated and analyzed using descriptive and inferential statistics to assess all the parameters. The mean and standard deviation was used to find out the effectiveness of Autogenic Drainage and Postural Drainage from 1$^{st}$ day of treatment to 10$^{th}$ day of treatment.

- ❖ Data of pre and post treatment parameters were recorded as previously described in the procedure.
- ❖ Arithmetic Mean and Standard Deviation were calculated for each variable (series of reading).
- ❖ Arithmetic Mean was derived from adding all the score together and dividing the total by the number of scores.
- ❖ Standard Deviation (SD) was calculated by following formula

$$\sqrt{\frac{\Sigma(X - \bar{X})^2}{(n - 1)}}$$

where:

$X$ = each score
$\bar{X}$ = the mean or average
$n$ = the number of values
$\Sigma$ means we sum across the values

SD is the average amount of deviation and is computed by taking the square root of the variance score. The deviation provides information about the extent to which each score deviates from the mean.

Paired 't' tests were used to determine differences between pre and post treatment of the intra group.

$$t = \frac{\sum d}{\sqrt{\frac{n\sum d^2 - (\sum d)^2}{n - 1}}}$$

Where, $\sqrt{}$ = square root of the final calculation of everything under the Square root sign.

$\sum d$ = total of the difference.
$(\sum d)^2$ = total of the differences, squared.
$\sum d^2$ = total of the squared differences
N = No. subjects or pairs of matched subjects.
P = < 0.05 was taken as significant.

Unpaired ‘t’ tests were used to determine difference between pre and post treatment of the intergroup.

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{\left(\sum X_1^2 - \frac{(\sum X_1^2)}{n_1}\right) + \left(\sum X_2^2 - \frac{(\sum X_2^2)}{n_1}\right)}{(n_1 - 1) + (n_2 - 1)}} * \sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Where,

$X_1$ = mean of scores from condition 1.

$X_2$ = mean of scores from conditions 2.

$\sum X_1^2$ = square of each individual score from condition 1 totally.

$\sum X_2^2$ = square of each individual score from condition 2 totally.

$(\sum X_1)^2$= the total of the individual scores from condition 1 scored.

$(\sum X_2)^2$= the total of the individual scores from condition 2 scored.

$n_1$ = number of subjects in condition 1.
$n_2$ = number of subjects in condition 2.
P = < 0.05 was taken as significant.

## AUTOGENIC DRAINAGE: (Group A)

**TABLE. 5.1**

**Mean and SD changes of pre and post treatment in FVC in Group A**

| GROUP A | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| PRE | 20 | 2.574 | 0.3464 | t = 0.101 | p = 0.920 |
| POST | 20 | 2.566 | 0.3557 | | |
| DIFF | | 0.0075 | 0.3316 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of FVC in group A with $t = 0.101$.

**Graph: 5.1**

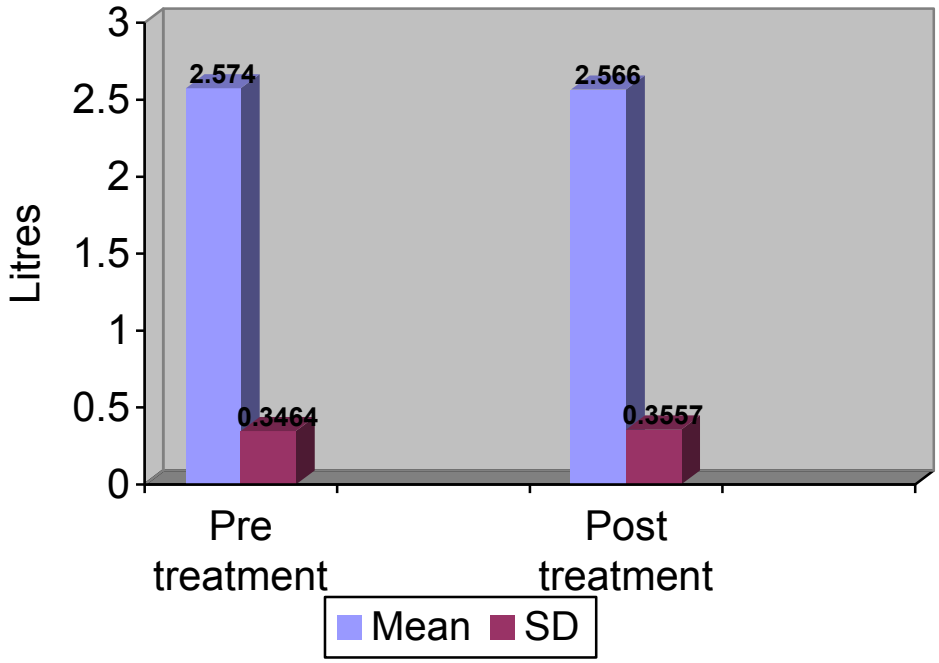


**Table 5.2:**

**Mean and SD changes of pre and post treatment in $FEV_1$**

| GROUP A | N | MEAN (litres) | SD | 't' values | 'p' values |
|---|---|---|---|---|---|
| **PRE** | 20 | 1.551 | 0.3309 | t = 1. 319 | p = 0.203 |
| **POST** | 20 | 1.678 | 0.3464 | | |
| **DIFF** | | 0.127 | 0.4306 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of $FEV_1$ in group A with t = 1. 319.

**Graph: 5.2**

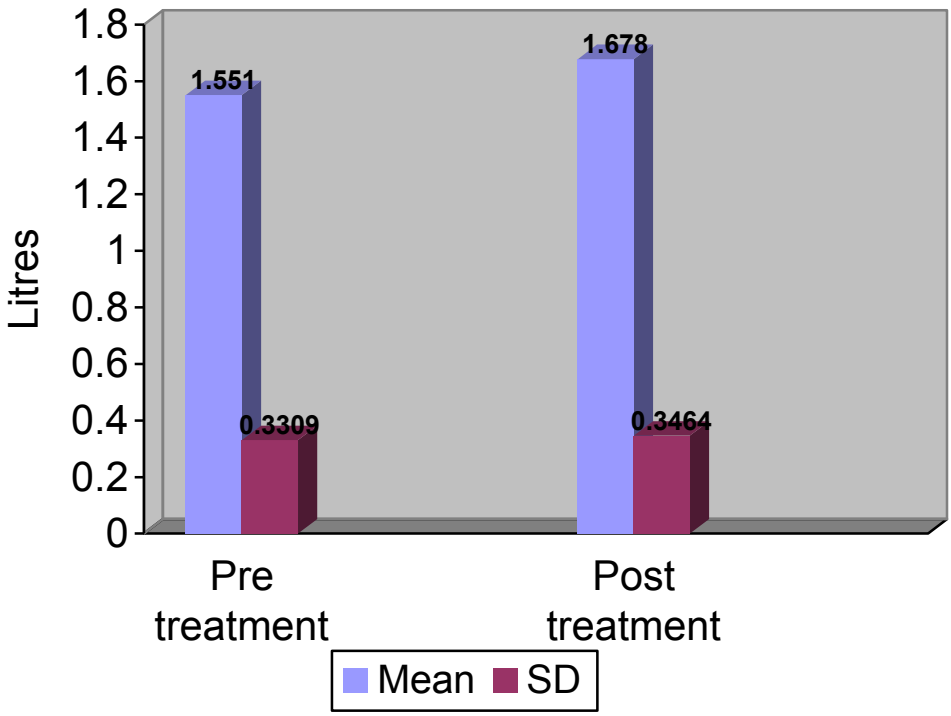


**Table: 5.3**

**Mean and SD changes of pre and post treatment in $FEV_1$ / FVC**

| GROUP A | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **PRE** | 20 | 58.1 | 11.16 | | |
| **POST** | 20 | 65.51 | 10.21 | 't' = 6.269 | p = 0.000 |
| **DIFF** | | 7.414 | 5.289 | | |

The $FEV_1$ / FVC changes in pre and post treatment is highly significant (p = 0.000) with t = 6.269.

**Graph: 5.3**

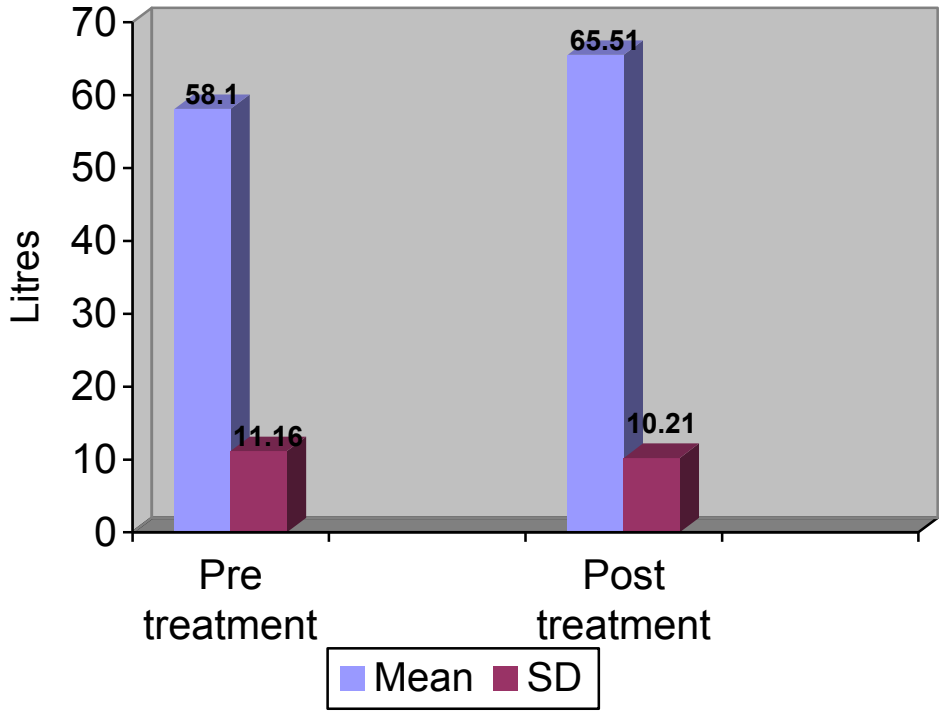


**Table 5.4**

**Mean and SD changes of pre and post treatment in ERV**

| GROUP A | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **PRE** | 20 | 0.596 | 0.4224 | 't' = 0.718 | p = 0.482 |
| **POST** | 20 | 0.4825 | 0.4509 | | |
| **DIFF** | | 0.1135 | 0.7072 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of ERV in group A with $t = 0.718$.

**Graph: 5.4.**

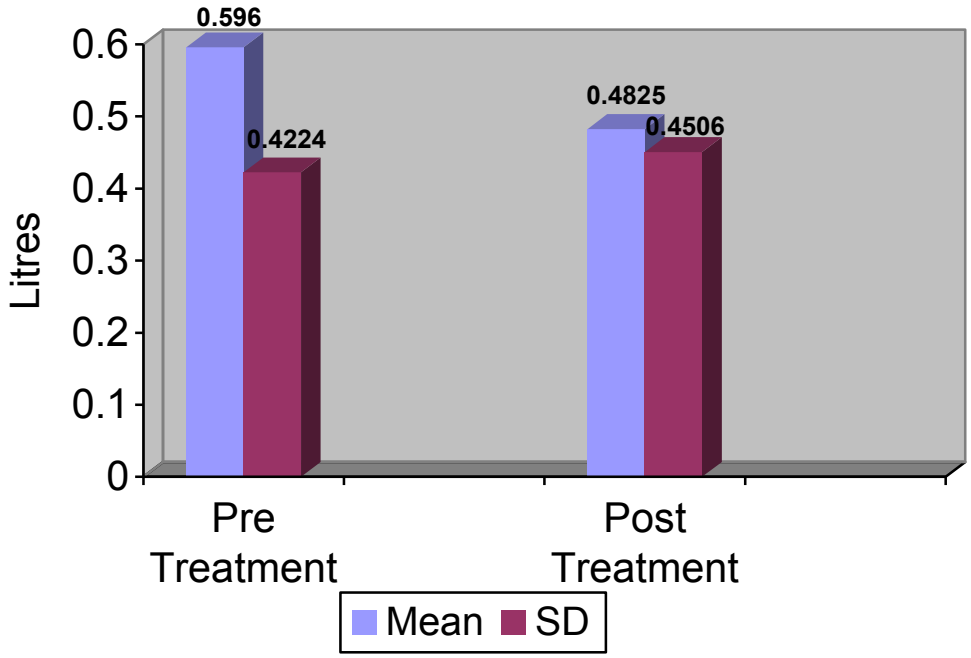


**Table 5.5:**

**Mean and SD changes of pre and post treatment in IRV**

| GROUP A | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| PRE | 20 | 0.7695 | 0.374 | 't' = 0.865 | P = 0.162 |
| POST | 20 | 0.8555 | 0.2511 | | |
| DIFF | | 0.086 | 0.4447 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of IRV in group A with $t = 0.865$.

**Graph: 5.5**

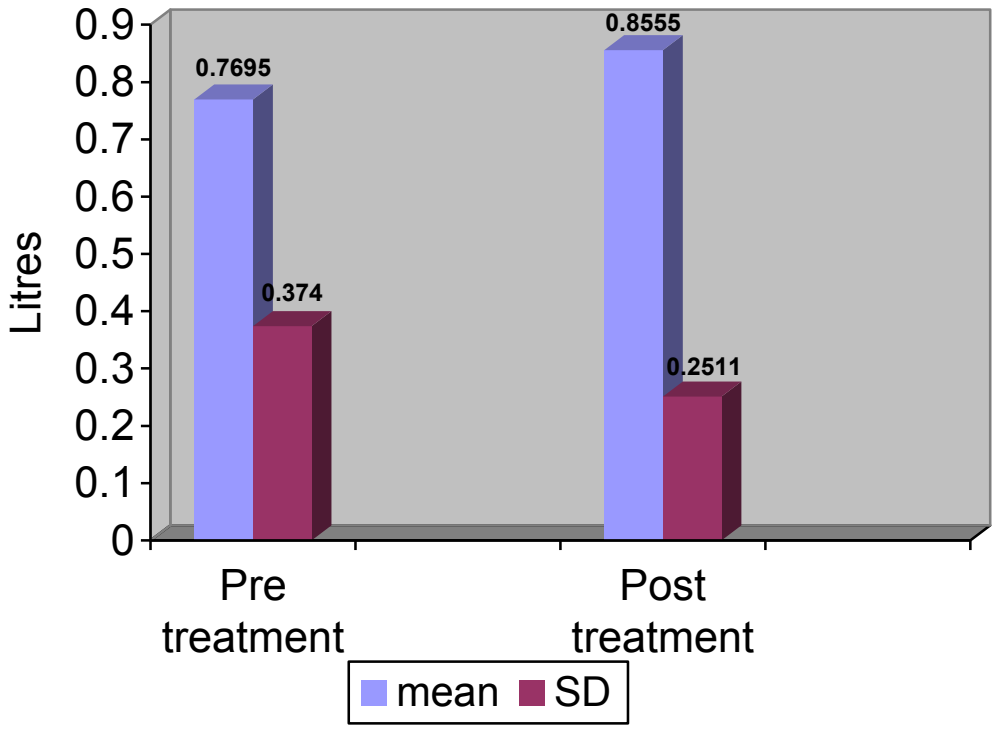


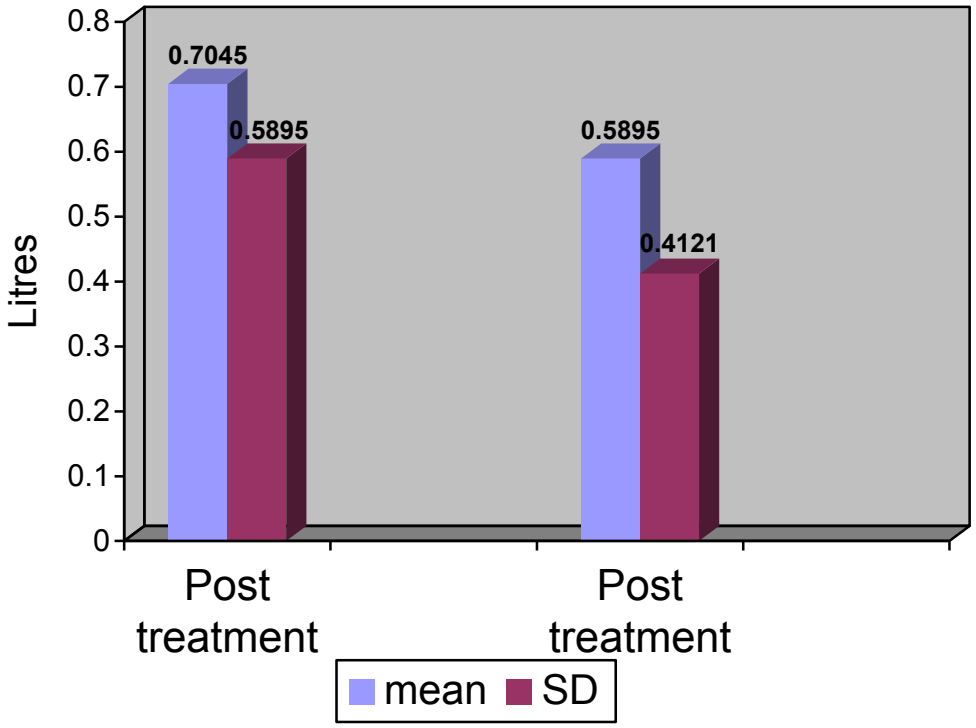
**Table 5.6:**

**Mean and SD changes of pre and post treatment in TV**

| GROUP A | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **PRE** | 20 | 0.7045 | 0.2925 | | |
| **POST** | 20 | 0.5895 | 0.4121 | 't' = 1.456 | p = 0.162 |
| **DIFF** | | 0.115 | 0.3532 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of TV in group A with $t = 1.456$.

**Graph: 5.6**



## POSTURAL DRAINAGE (GROUP B)

**Table 5.7:**

**Mean and SD changes in Pre an Post Treatment in FVC**

| GROUP B | N | MEAN (Litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **PRE** | 20 | 2.43 | 0.2445 | 't' = 1.959 | p = 0.065 |
| **POST** | 20 | 2.301 | 0.2625 | | |
| **DIFF** | | 0.129 | 0.2945 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of FVC in group B with $t = 1.959$.

**Graph: 5.7**

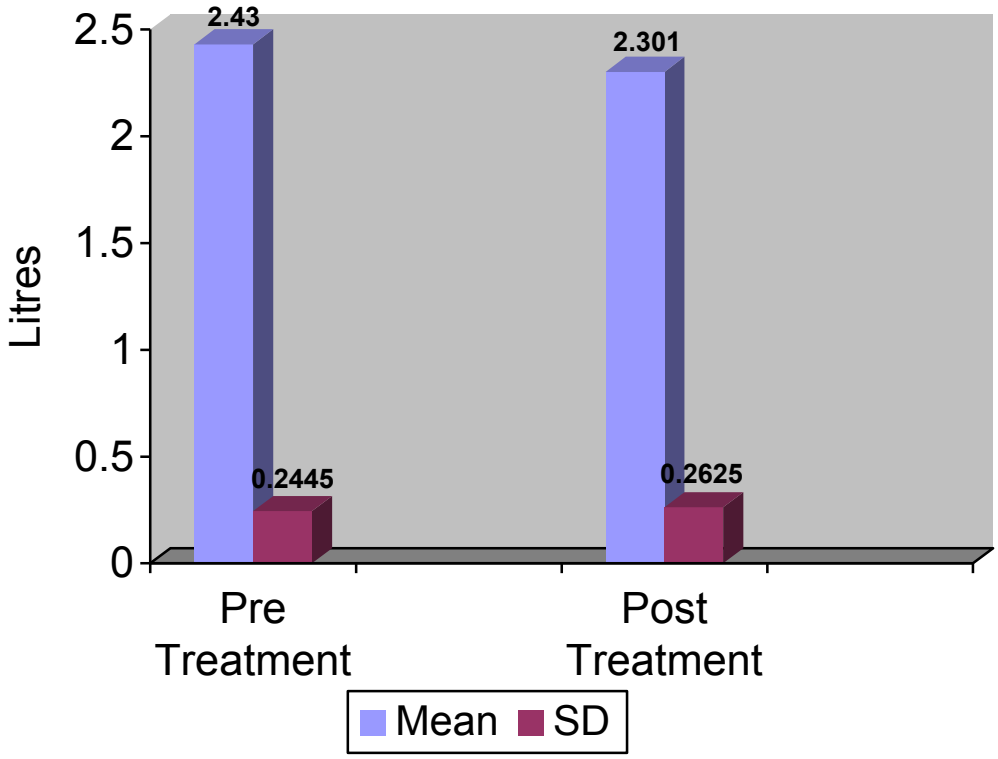


**Table 5.8:**

**Mean and SD changes of Pre and Post treatment in $FEV_1$**

| GROUP B | N | MEAN (Litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **PRE** | 20 | 1.51 | 0.2804 | | |
| **POST** | 20 | 1.471 | 0.2881 | 't' = 1.139 | p = 0.269 |
| **DIFF** | | 0.03895 | 0.153 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of $FEV_1$ in group B with $t = 1.139$.

**Graph: 5.8**

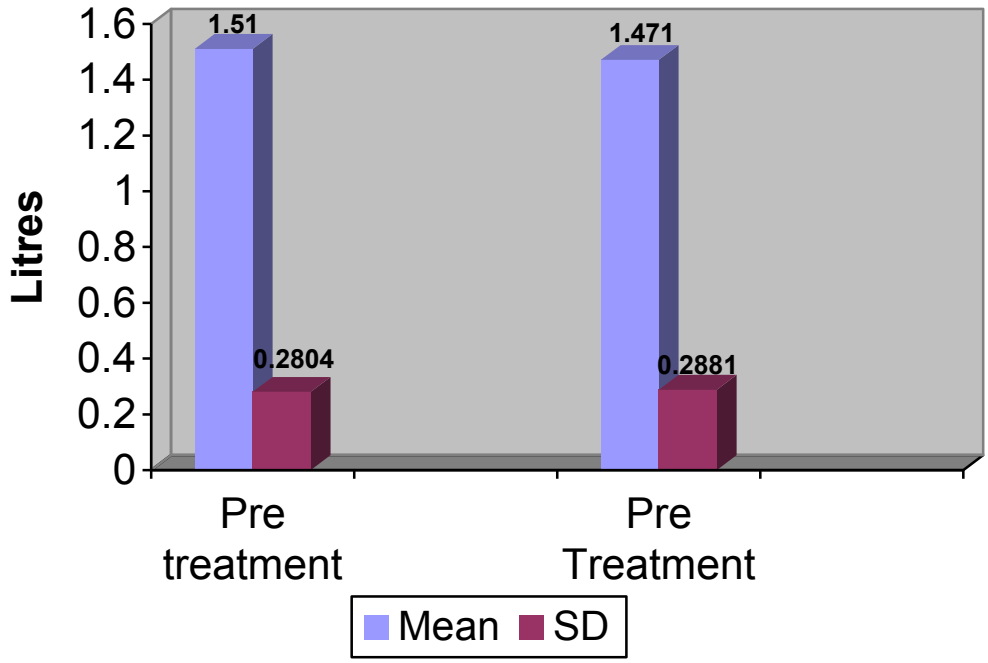


**Table 5.9:**

**Mean and SD changes of Pre and Post treatment in $FEV_1$ / FVC**

| GROUP B | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **PRE** | 20 | 62.39 | 11.46 | | |
| **POST** | 20 | 63.98 | 11.29 | 't' = 1.586 | p = 0.129 |
| **DIFF** | | 1.592 | 4.49 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of $FEV_1$/FVC in group B with t = 1.586.

**Graph: 5.9**

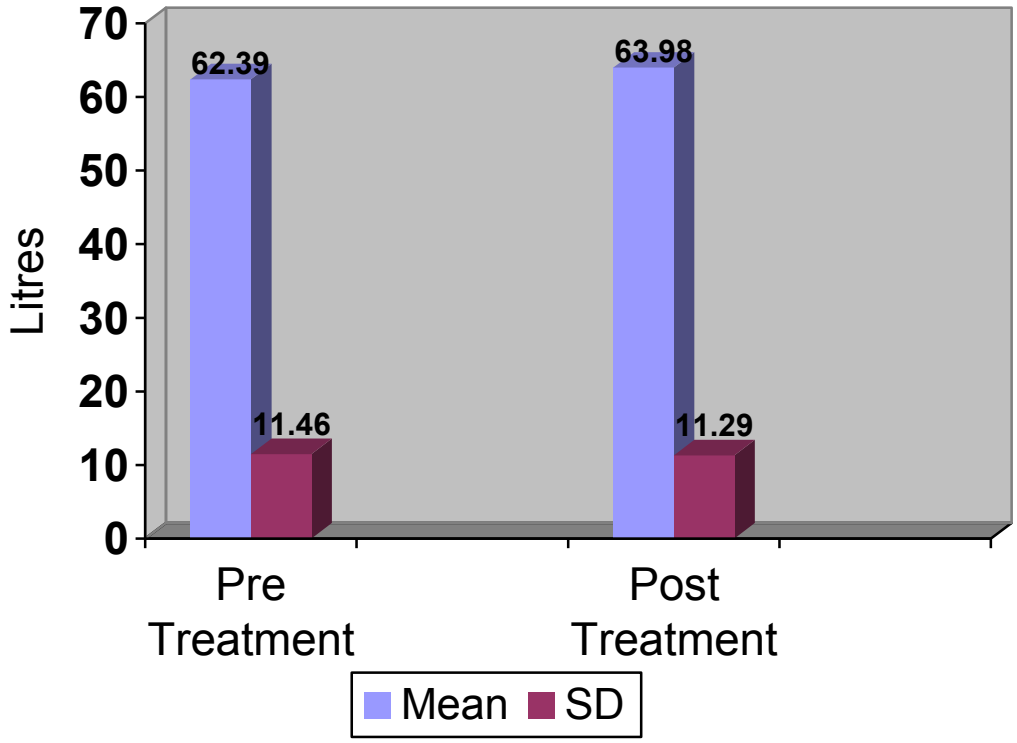


**Table 5.10:**

**Mean and SD changes of Pre and Post treatment in ERV**

| GROUP B | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| PRE | 20 | 0.448 | 0.3744 | t = 0.245 | p = 0.809 |
| POST | 20 | 0.4235 | 0.431 | | |
| DIFF | | 0.0245 | 0.4469 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of ERV in group B with $t = 0.245$.

**Graph: 5.10**

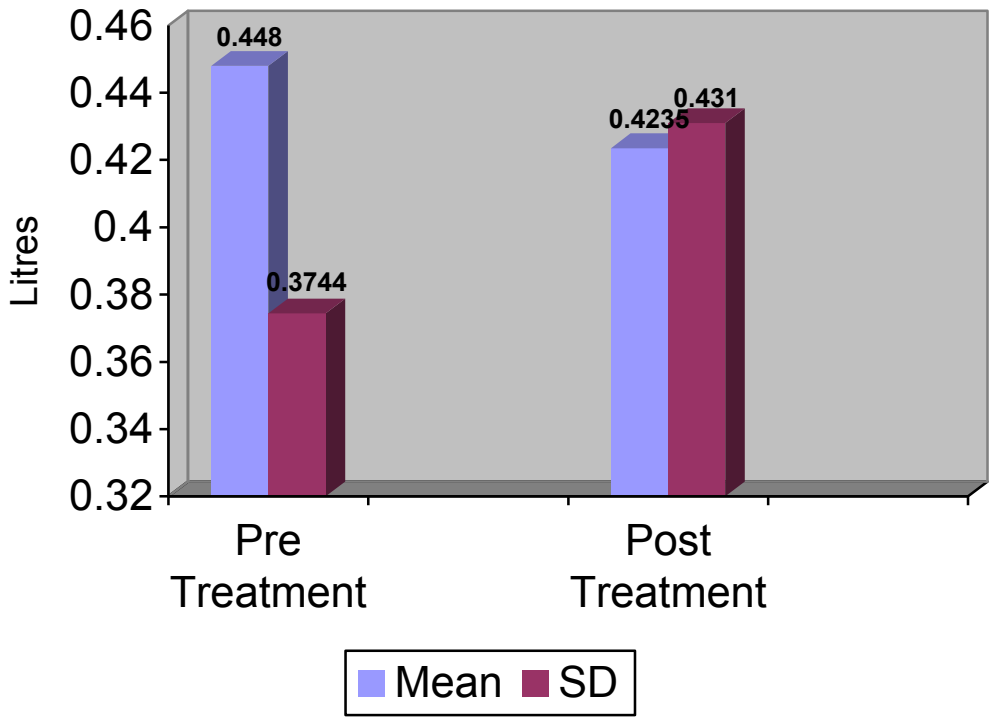


**Table 5.11:**

**Mean and SD changes of pre and post treatment in IRV**

| GROUP B | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **PRE** | 20 | 0.8145 | 0.3396 | 't' = 0.586 | p = 0.565 |
| **POST** | 20 | 0.758 | 0.32 | | |
| **DIFF** | | 0.565 | 0.4315 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of IRV in group B with $t = 0.586$.

**Graph: 5.11**

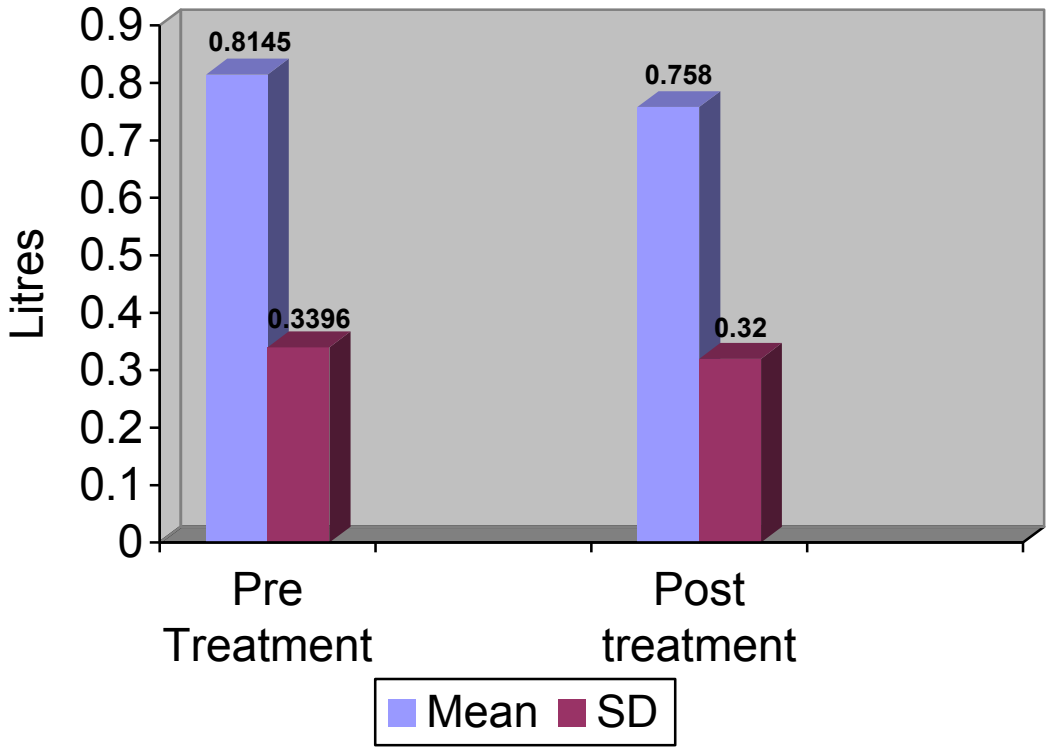


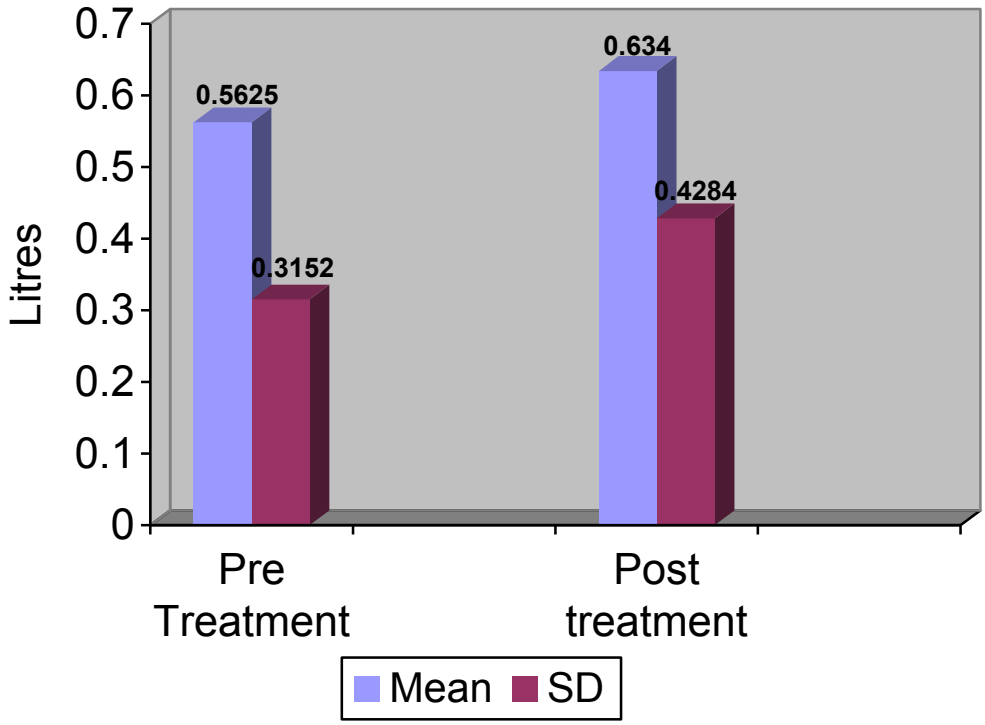
**Table 5.12:**

**Mean and SD changes of pre and post treatment in TV**

| GROUP B | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **PRE** | 20 | 0.5625 | 0.3152 | 't' = 0.670 | p = 0.511 |
| **POST** | 20 | 0.634 | 0.4284 | | |
| **DIFF** | | 0.0715 | 0.4774 | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of TV in group B with $t = 0.670$.

**Graph: 5.12**



**COMPARISSION BETWEEN**

**POSTURAL DRAINAGE Vs AUTOGENIC DRAINAGE**

**Table 5.13:**

**Mean and SD changes of AD and PD in FVC**

| GROUP | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **AD** | 20 | 0.129 | 0.1964 | 't' = 1.410 | p = 0.167 |
| **PD** | 20 | 0.0075 | 0.3316 | | |
| **DIFF** | | 0.1215 | | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of FVC in group B with $t = 1.410$.

**Graph: 5.13**

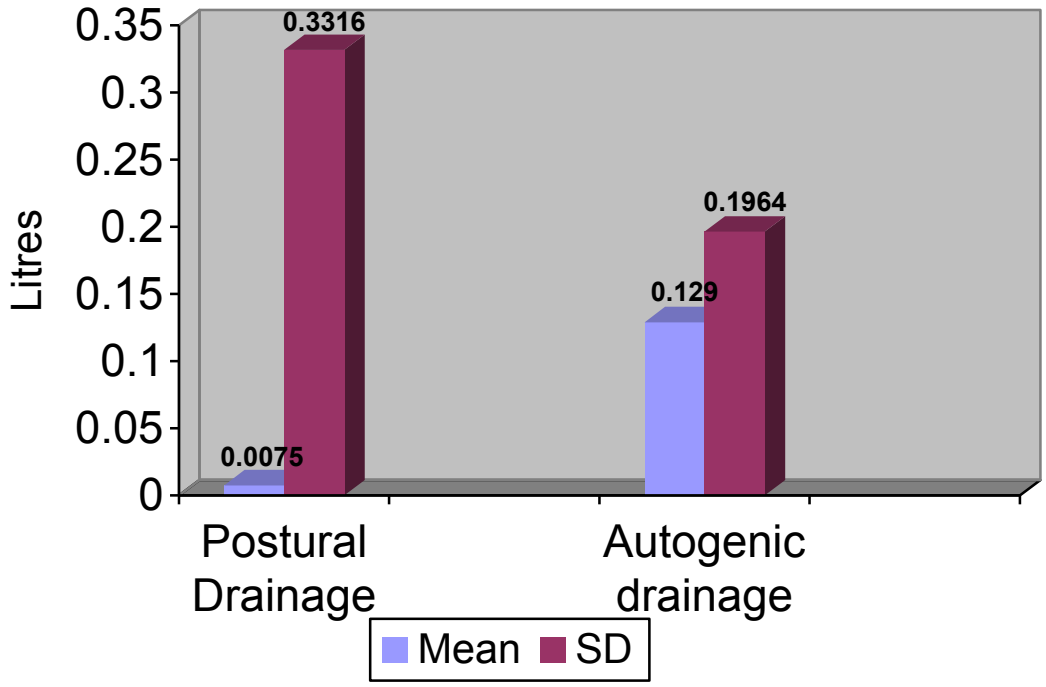


**Table 5.14:**

**Mean and SD changes of AD and PD in $FEV_1$**

| GROUP | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **AD** | 20 | 0.039 | 0.153 | 't' = 1.726 | p = 0.093 |
| **PD** | 20 | 0.115 | 0.3588 | | |
| **DIFF** | | 0.1505 | | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of $FEV_1$ in group B with $t = 1.726$.

**Graph: 5.14**

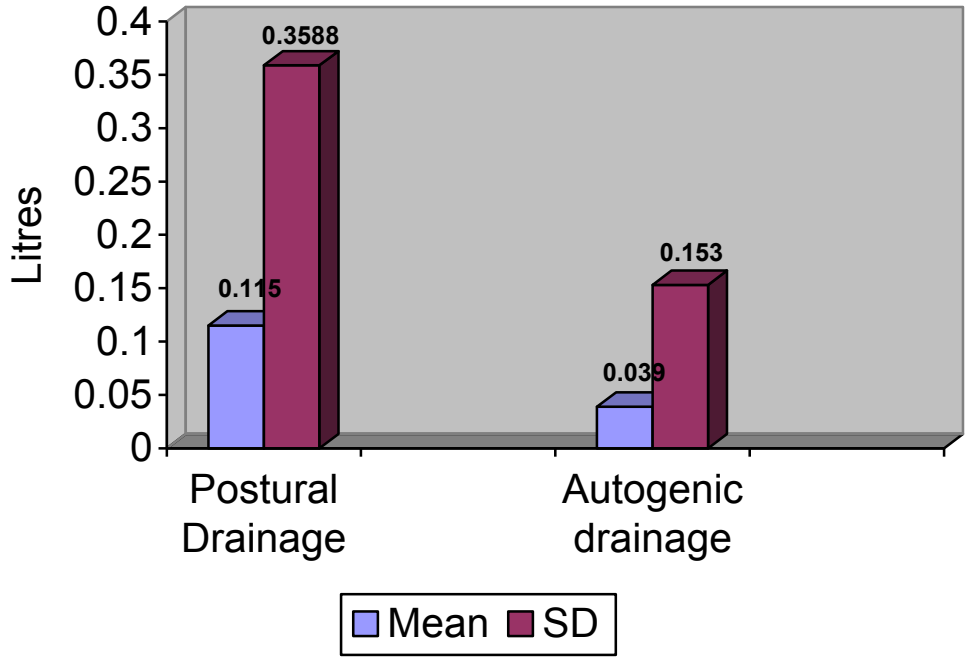


**Table 5.15:**

**Mean and SD changes of AD and PD in $FEV_1$ / FVC**

| GROUP | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **AD** | 20 | 1.592 | 3.159 | 't' = 3.044 | P = 0.004 |
| **PD** | 20 | 16.46 | 21.61 | | |
| **DIFF** | | 14.87 | | | |

The $FEV_1$ / FVC changes in pre and post treatment is highly significant (p = 0.000) with t = 3.044.

**Graph: 5.15.**

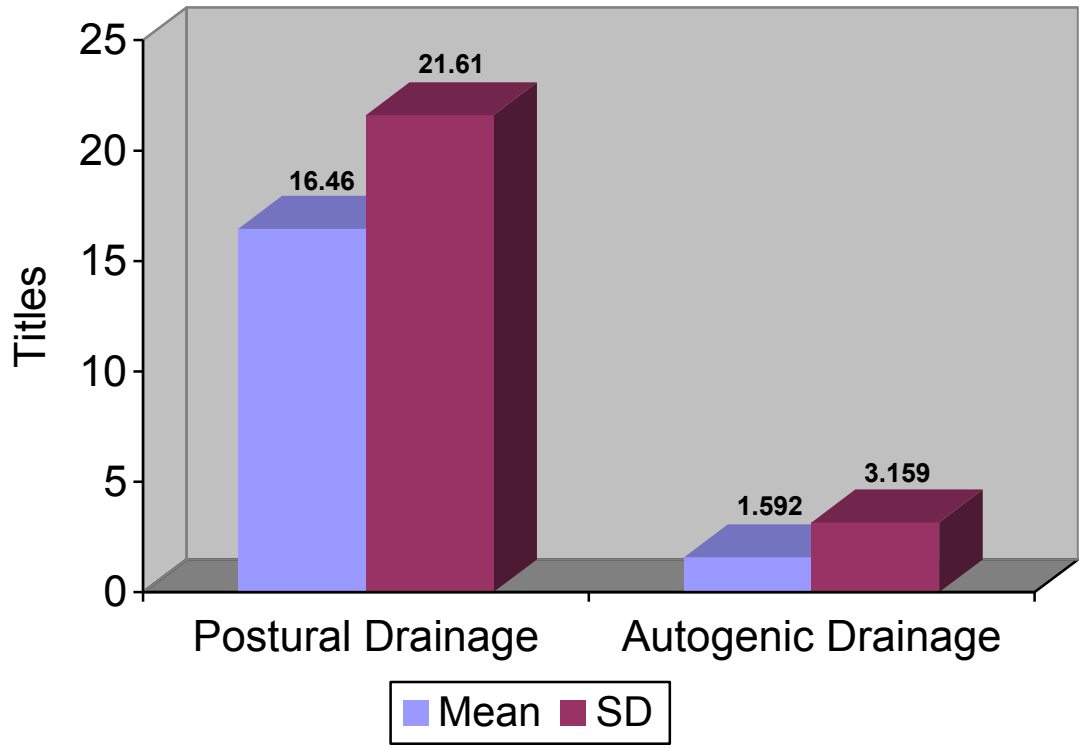


**Table 5.16:**

**Mean and SD changes of AD and PD in ERV**

| GROUP | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **AD** | 20 | 0.0245 | 0.455 | 't' = 0.530 | p = 0.599 |
| **PD** | 20 | 0.1135 | 0.5972 | | |
| **DIFF** | | 0.089 | | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of ERV in group B with $t = 0.530$.

**Graph: 5.16**

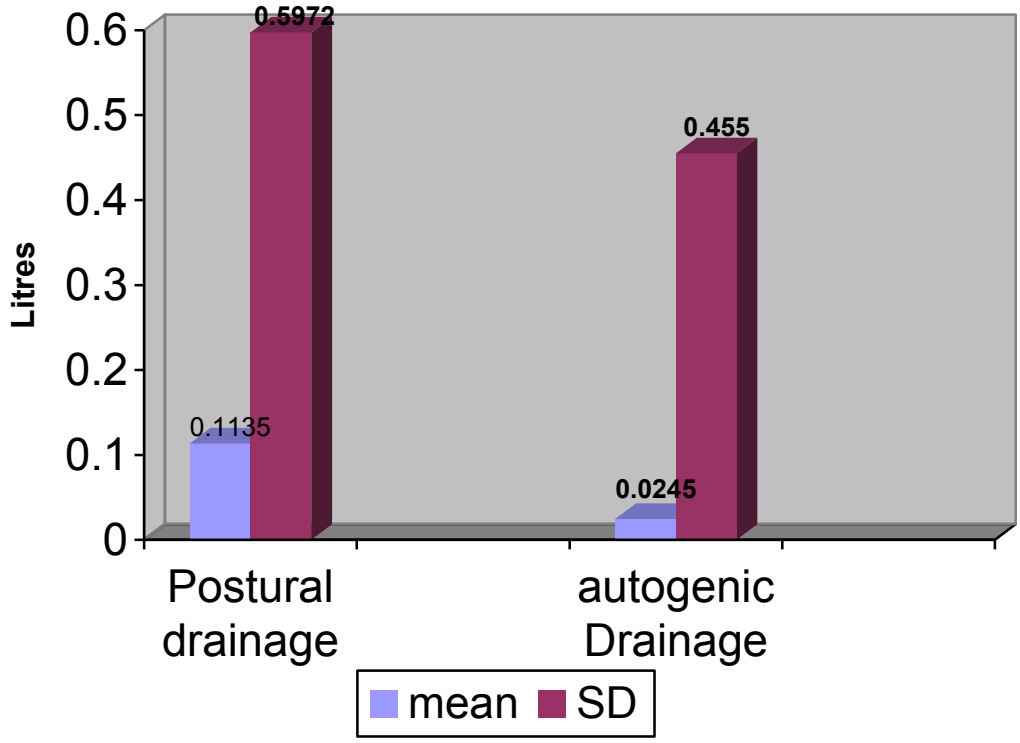


**Table 5.17:**

**Mean and SD changes of AD and PD in IRV**

| GROUP | N | MEAN (litres) | SD | 't' value | 'p' value |
|---|---|---|---|---|---|
| **AD** | 20 | 0.053 | 0.3597 | 't' = 1.074 | p = 0.290 |
| **PD** | 20 | 0.086 | 0.4535 | | |
| **DIFF** | | 0.139 | | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of IRV in group B with $t = 1.074$.

**Graph: 5.17.**

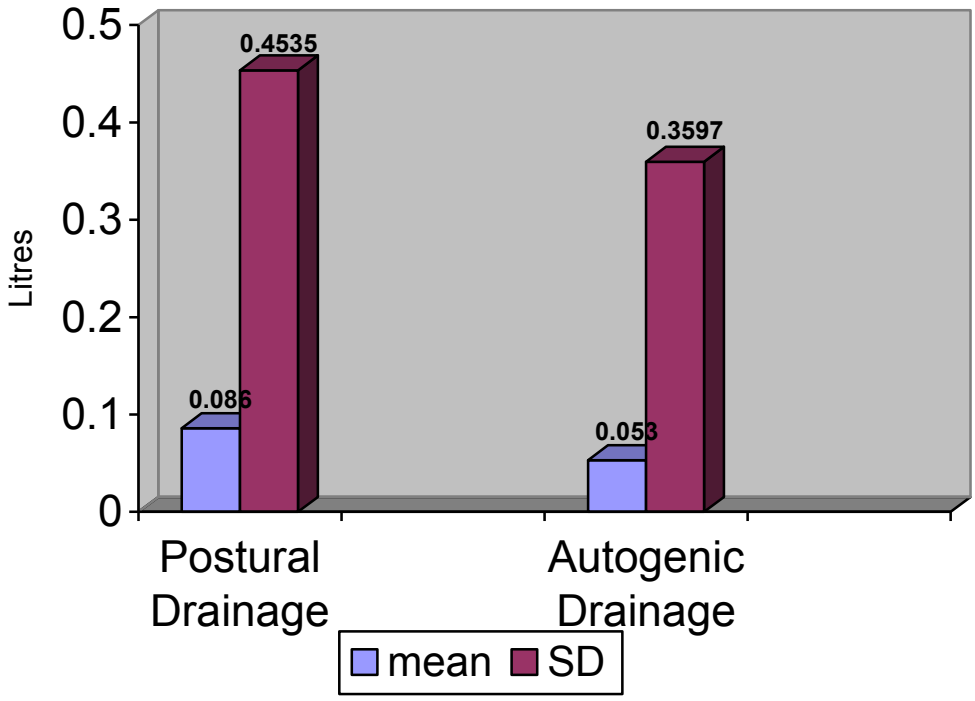


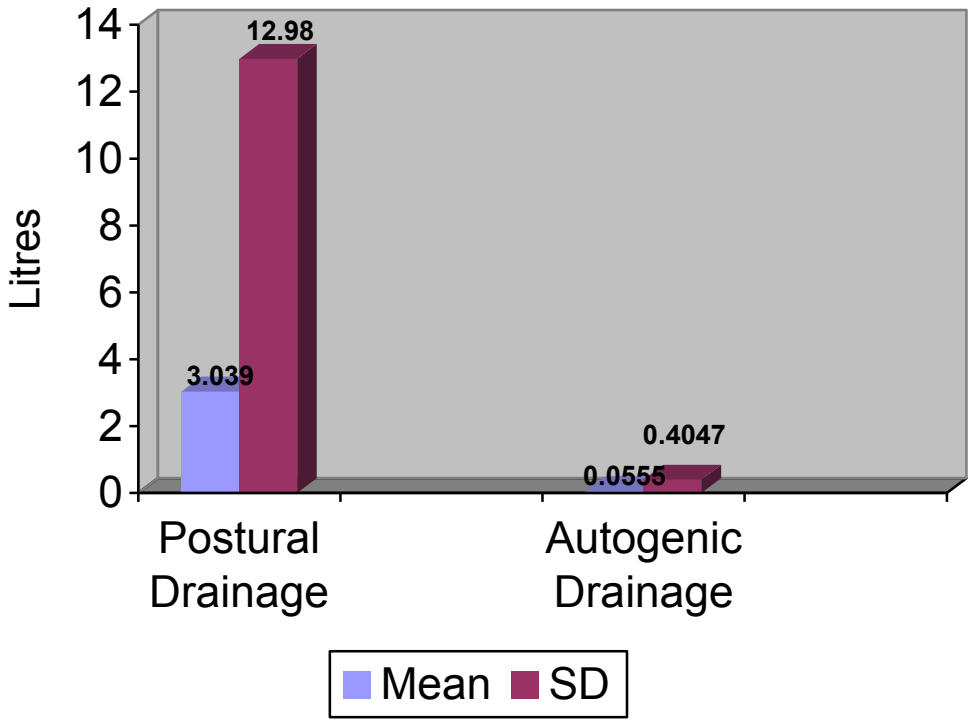
**Table: 5.18**

**Mean and SD changes of AD and PD in TV**

| GROUP | N | MEAN (litres) | SD | 't' value | 'p'value |
|---|---|---|---|---|---|
| **AD** | 20 | 0.0555 | 0.4047 | 't' = 1.066 | p = 0.293 |
| **PD** | 20 | 3.039 | 12.98 | | |
| **DIFF** | | 3.094 | | | |

There was no significant change ($p > 0.05$) in the pre and post treatment values of TV in group B with $t = 1.066$.

**Graph: 5.18.**



# RESULT

The unpaired ‘t’ test between the pre and post treatment values in Group A showed no significant changes in FVC with a ‘t’= 0.101, p = 0.920; for FEV1 showed no significant changes with ‘t’ = 1.319, p = 0.203; for ERV showed no significant changes with ‘t’ = 0.718, p = 0.482; for IRV showed no significant changes with ‘t’ = 0.865, p = 0.162; for TV showed no significant changes with ‘t’ = 1.456, p = 0.162; for FEV1 / FVC showed high significance with ‘t’ = 6.269, p = 0.000.

The unpaired ‘t’ test between the pre and post treatment values in Group B showed no significant changes in FVC with a ‘t’= 1.959, p = 0.065; for FEV1 showed no significant changes with ‘t’ = 1.139, p = 0.269; for ERV showed no significant changes with ‘t’ = 0.245, p = 0.809; for IRV showed no significant changes with ‘t’ = 0.586, p = 0.565; for TV showed no significant changes with ‘t’ = 0.670, p = 0.511; for FEV1 / FVC showed no significance with ‘t’ = 1.586, p = 0.129.

When unpaired ‘t’ test was used to determine difference between pre and post treatment values of the intergroup showed no significant changes in FVC with a ‘t’= 1.410, p = 0.167; for FEV1 showed no significant changes with ‘t’ = 1.726, p = 0.093; for ERV showed no significant changes with ‘t’ = 0.530, p = 0.599; for IRV showed no significant changes with ‘t’ = 1.074, p = 0.290; for TV showed no significant changes with ‘t’ = 1.066, p = 0.293; for FEV1 / FVC showed high significance with ‘t’ = 3.044, p = 0.004.

# DISCUSSION

Many studies have investigated the effects of bronchial drainage techniques on pulmonary function and reported that conventional physiotherapy methods or a combination of different techniques could maintain or improve the pulmonary function test parameters including $FEV_1$/FVC, ERV, and IRV.

Leister et al.,[17] studied a two separate groups of cystic fibrosis patients for a period of 14 days. Group I patients were treated preferentially with AD in combination of a positive expiratory pressure mask. In Group II individualized treatment procedures were used as preferred by the patients. They found that pulmonary function tests and SaO2 improved significantly after both treatments. In my study FVC, $FEV_1$, $FEV_1$/FVC. ERV, IRV, TV after PD does not show any significance ($P > 0.05$) but $FEV_I$ / FVC improved significantly ($P < 0.05$).

In this study, it includes a three phase breathing exercise. The gradually increasing Inspiratory and expiratory reserve volumes from functional residual capacity and a 2 to 3 sec. breath holding period resulted in collateral filling among the alveoli and improved ventilation and mobilized secretions. PD consists of adopting a position in which the lobe to be drained is uppermost, thereby allowing secretions in the dilated bronchi to gravitate towards the teacher, from which they can readily be cleaned by vigorous coughing. Giles et al[18] stated that AD is related to mucus clearing. In addition, positioning given in PD is

designed to improve the mobilization of bronchial secretions aid to normalize functional residual capacity based on the effects of gravity. It is noted that AD and OD used in this study improve lung function by ensuring collateral vent in segments of lung.

In this study no statistical significant improvement was found in FVC, $FEV_1$, ERV, IRV and TV in both groups except $FEV_1$/FVC in AD. No statistical significance is probably because of less number of data. But clinically noticeable improvement in all the parameters was seen in both the groups. Probably it may be because both the techniques are effective in mucus clearance but it is also noticed that AD is more effective than PD because in AD patient is asked not do nonproductive coughing which can cause collapse of the airways whereas in PD no such instructions are given to the patient.

Donald R Giles[18] investigated the effects of AD and PD in cystic fibrosis. Ten patients were diagnosed as having cystic fibrosis and each patient received both AD and PD on separate days. He found that both AD and PD have similar effects in patients and mucus clearance has similar. Although, both techniques AD and PD improved clinically the increase in AD group was significantly higher than in PD groups. This could be probably because of a larger airflow without an airway collapse and better co-operation requirements between the patient and the physiotherapist in AD technology. A conditions auditory feedback was given to the patient during the application of AD treatment.

# CONCLUSION

The study reveals that both AD and PD are effective techniques in the clearance of mucus which is one of the causes of airway obstruction in patients with COPD as shown in pulmonary function test. Although AD technique was more difficult for patients to learn, but once the patients used the techniques correctly it was found to be effective. The PFT values have improved in both the groups with a good FEV1 / FVC ration through AD techniques which is suggestive of an improved airway entry which is quite possible with a clear lung, and thus by reducing the dead space. However the patient's compatibility has to be kept into consideration.

As it is evident that both the techniques were effective it can be said that no single technique is better than the other. So an individual adjustment of a specific technique has to be determined for every patient. General rules can not be given but guidelines can be suggested to adjust the technique towards the need of the patient. the best treatment technique for any patient is the one which the patients feels most comfortable, which he is able to continue, which provides larger mucus clearance and which maintains acceptable health according to the stage of disease.

# LIMITATIONS

This study was evident to prove an improvement in PFT values in both the groups but still the functional capabilities of the patients were unknown. This could have been identified if the $O_2$ saturation level and the sputum measurements were done to identify their efficiency and ability of functional activities.

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# APPENDICES

## APPENDIX 1–CONCENT FORM

**Date:**

You are requested to be a part of this research study, which is part of the curriculum for the course of MPT run by the DR. MGR University of Health Sciences. To identify an effective technique for airway clearance and to improve pulmonary function. Your participation will consist essentially of attending daily for 10 days each session approximately for 30 minutes. You will be either treated with autogenic drainage or postural drainage. This exercise will not cause any harm to you.

Permission for this study has been acquired from the hospital authorities. We will clarify any of your queries regarding the study. Your identity will remain confidential. You are free to leave this study at any time. You are requested to sign this consent form.

Sign _____

I voluntarily agree to participate in this research study. I am fully aware of the procedure that will be carried.

# ASSESSMENT CHART

1. NAME :

2. AGE :

3. SEX :

4. ADDRESS :

5. OCCUPATION :

6. CHIEF COMPLAINTS :

7. HOPI (SYMPTOMS) :

a) Dysponea:

i. Duation :

ii. Onset : Sudden / Gradual

iii. On Exertion : Increase / Normal

iv. Aggravating factors :

v. Relieving factors :

b) Cough:

i. Duration :

ii. Onset : Sudden / gradual

iii. Type : Productive / Non-productive

c) Expectoration

i. Quantity / day :

ii. Quality :

iii. Colour :

iv. Odour :

d) Chest Pain : Present / Absent

e) Oedema : Pittable / Non-pittable.

f) Haemoptasis : Present / Absent

g) Fever : Present / Absent

h) Allergy : Present / Absent

8. Past History:

- H/O similar complaints : Present / Absent
- H/O similar episodes in same season : Present / Absent

9. Past Medical History : Heart attack / High BP / DM / TB

10. Personal History

- Smoking : Cigarette / Bidi / Tobbaco
- Frequency / Day :
- Alcoholism : Yes / No

11. Family History : Present / Absent / Not significant.

## PHYSICAL EXAMINATION

### A) General Exam

1. Vital signs:
   a. Temperature : Normal / High
   b. Pulse rate :
   c. RR :
   d. BP :
2. Built : Weak / Average / Obese
3. Nutrition : Poor / Moderate / Good
4. Pallor : Present / Absent
5. Lymphadenopathy : Present / Absent

Clubbing : Present / Absent

1. Grade 1
2. Grade 2
3. Grade 3
4. Grade 4

**B) Examination of Respiratory System**

1. Inspection:
    a. Shape of Chest :
    b. Respiratory Movements:
        i. Respiratory Rate : (Normal / Increased / Decreased)
        ii. Respiratory Rhythm : (Regulatory / Irregular)
        iii. Equality : (Equal / Unequal)
    c. Type of Breathing :
    d. I : E Ratio :
    e. Use of accessory muscle : (Present / Absent)

2. Palpation:
    a. Tracheal shift :
    b. Apex beat : Palpable / Not palpable
    c. TVF : (Equal / Increased / Decreased)
    d. Chest Expansion
        i. Supra Mammary :
        ii. Mammary :
        iii. Infra Mammary :

3. Percussion
    a. (Impaired / Stony Dill / Dull / Tympanic / Resonant / Hyper resonant)

4. Auscultation:
    a. Breath sound: (Vesicular / bronchial / Bronchio-Vesicular)
    b. Additional sounds: (Rales / Ronchi / Stridor / Rub)
    c. Vocal resonance: (Normal / Absent / Increased)

5. Investigation
    a. Chest X – ray :
    **b. Pulmonary Function Test :**

| **Measure** | **Day 1 (Pre-treatment)** | **Day 10 (Post-treatment)** |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# MASTER CHART: Autogenic Drainage

| S.no | Age | Pre Treatment | | | | | | Post treatment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FVC | FEV1 | FEV1/FVC | ERV | IRV | TV | FVC | FEV1 | FEV1/FVC | ERV | IRV | TV |
| 1 | 50 | 02.51 | 02.32 | 35.06 | 00.20 | 01.54 | 00.42 | 02.65 | 01.24 | 46.79 | 01.59 | 00.79 | 00.33 |
| 2 | 50 | 03.17 | 01.66 | 50.76 | 01.62 | 01.33 | 00.82 | 03.12 | 02.04 | 65.38 | 00.21 | 00.76 | 00.72 |
| 3 | 45 | 02.36 | 001.19 | 50.42 | 00.28 | 00.87 | 00.33 | 02.39 | 01.17 | 48.95 | 00.04 | 01.26 | 00.07 |
| 4 | 50 | 02.93 | 02.20 | 75.09 | 00.45 | 00.01 | 00.77 | 03.36 | 02.69 | 80.06 | 00.77 | 00.59 | 00.39 |
| 5 | 48 | 02.42 | 01.76 | 72.73 | 01.11 | 00.53 | 00.46 | 01.97 | 01.58 | 80.20 | 00.56 | 01.02 | 00.50 |
| 6 | 55 | 02.67 | 01.18 | 44.19 | 00.55 | 00.50 | 00.65 | 02.54 | 01.43 | 56.30 | 00.08 | 00.95 | 00.45 |
| 7 | 50 | 02.28 | 01.07 | 49.63 | 00.37 | 00.21 | 00.85 | 02.52 | 01.30 | 51.50 | 00.59 | 01.17 | 00.52 |
| 8 | 49 | 02.41 | 01.37 | 56.85 | 00.97 | 01.42 | 00.61 | 02.16 | 01.68 | 77.78 | 00.25 | 00.80 | 00.38 |
| 9 | 50 | 02.10 | 01.57 | 74.76 | 00.41 | 00.72 | 00.29 | 02.12 | 01.67 | 78.77 | 01.37 | 00.70 | 00.63 |
| 10 | 40 | 03.29 | 01.50 | 45.59 | 00.61 | 00.95 | 00.77 | 02.82 | 01.59 | 56.38 | 00.15 | 01.00 | 00.05 |
| 11 | 48 | 02.36 | 01.60 | 67.80 | 00.71 | 00.91 | 00.41 | 02.55 | 01.88 | 73.73 | 00.80 | 00.89 | 00.50 |
| 12 | 40 | 02.82 | 01.83 | 64.89 | 00.39 | 00.67 | 00.45 | 02.76 | 01.83 | 66.30 | 00.46 | 00.39 | 00.50 |
| 13 | 50 | 02.14 | 01.15 | 53.74 | 00.16 | 00.76 | 01.21 | 03.01 | 01.85 | 61.46 | 00.10 | 00.15 | 01.80 |
| 14 | 39 | 02.96 | 01.54 | 60.16 | 00.47 | 00.67 | 00.81 | 02.55 | 01.74 | 68.24 | 00.23 | 00.69 | 01.50 |
| 15 | 50 | 02.41 | 01.15 | 47.72 | 00.15 | 01.08 | 00.40 | 02.05 | 01.18 | 57.56 | 00.07 | 01.17 | 00.02 |
| 16 | 49 | 02.63 | 01.60 | 60.84 | 00.32 | 00.64 | 00.90 | 02.76 | 01.91 | 69.20 | 00.43 | 00.75 | 00.48 |
| 17 | 45 | 02.50 | 01.65 | 66.00 | 01.46 | 00.60 | 01.35 | 02.52 | 01.73 | 68.65 | 01.15 | 00.80 | 00.62 |
| 16 | 46 | 02.06 | 01.42 | 68.93 | 00.89 | 00.77 | 01.08 | 02.42 | 01.77 | 73.14 | 00.17 | 00.95 | 00.71 |
| 19 | 40 | 02.92 | 01.76 | 60.27 | 00.15 | 00.72 | 00.69 | 02.72 | 01.78 | 65.44 | 00.13 | 00.65 | 00.93 |
| 20 | 44 | 02.53 | 01.50 | 59.29 | 00.65 | 00.49 | 00.82 | 02.33 | 01.50 | 64.38 | 00.50 | 01.13 | 01.14 |

## PRE TREATMENT

| | FVC | FEV1 | FEV1/FVC | ERV | IRV | TV |
|---|---|---|---|---|---|---|
| **Mean** | 2.5735 | 1.551 | 58.101 | 0.596 | 0.7695 | 0.7045 |
| **SD** | 0.346445 | 0.33093 | 11.15629 | 0.422392 | 0.374032 | 0.2927272 |

## POST TREATMENT

| | FVC | FEV1 | FEV1/FVC | ERV | IRV | TV |
|---|---|---|---|---|---|---|
| **Mean** | 2.566 | 1.92 | 65.515 | 0.48 | 0.8555 | 0.5895 |
| **SD** | 0.355682 | 0.346359 | 10.20511 | 0.449374 | 0.251071 | 0.412125 |

# Postural Drainage

| S.No | Age | Pre Treatment | | | | | | Post treatment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FVC | FEV1 | FEV1/FVC | ERV | IRV | TV | FVC | FEV1 | FEV1/FVC | ERV | IRV | TV |
| 1 | 50 | 02.20 | 01.65 | 75.00 | 00.82 | 00.67 | 00.62 | 02.07 | 01.60 | 77.29 | 00.15 | 00.33 | 00.85 |
| 2 | 45 | 02.47 | 01.63 | 65.99 | 00.49 | 00.64 | 00.73 | 02.46 | 01.72 | 69.92 | 00.87 | 00.45 | 00.80 |
| 3 | 48 | 02.43 | 00.76 | 31.28 | 00.61 | 00.93 | 01.16 | 02.55 | 00.84 | 32.94 | 00.26 | 00.72 | 00.77 |
| 4 | 40 | 02.44 | 01.47 | 60.25 | 00.02 | 01.33 | 00.04 | 02.18 | 01.43 | 65.60 | 00.54 | 01.15 | 01.11 |
| 5 | 35 | 02.69 | 01.30 | 48.33 | 00.72 | 00.43 | 00.42 | 02.37 | 01.31 | 55.27 | 00.56 | 01.50 | 00.07 |
| 6 | 50 | 02.67 | 01.65 | 61.80 | 00.15 | 01.13 | 00.42 | 02.41 | 01.50 | 62.24 | 00.22 | 00.85 | 00.08 |
| 7 | 45 | 01.72 | 01.21 | 70.35 | 01.10 | 01.51 | 00.93 | 01.78 | 01.29 | 72.47 | 00.15 | 00.96 | 00.01 |
| 8 | 47 | 02.23 | 01.73 | 77.58 | 00.08 | 00.38 | 00.54 | 01.97 | 01.40 | 71.07 | 00.06 | 00.80 | 00.57 |
| 9 | 46 | 02.42 | 01.63 | 67.36 | 00.36 | 00.98 | 00.41 | 01.98 | 01.33 | 67.17 | 00.33 | 00.98 | 00.11 |
| 10 | 50 | 02.18 | 01.24 | 56.88 | 00.41 | 00.86 | 00.37 | 02.02 | 01.11 | 54.95 | 00.05 | 00.76 | 00.44 |
| 11 | 49 | 02.27 | 00.99 | 43.61 | 00.05 | 00.56 | 00.02 | 02.14 | 00.99 | 43.61 | 00.05 | 00.56 | 00.02 |
| 12 | 48 | 02.83 | 01.63 | 57.60 | 01.09 | 01.00 | 00.51 | 02.18 | 01.31 | 60.09 | 01.89 | 00.84 | 00.64 |
| 13 | 40 | 02.33 | 01.70 | 72.96 | 00.14 | 00.27 | 00.83 | 02.33 | 01.81 | 77.68 | 00.61 | 00.64 | 01.02 |
| 14 | 39 | 02.46 | 01.58 | 64.23 | 00.56 | 00.67 | 00.50 | 02.40 | 01.46 | 60.83 | 00.85 | 00.84 | 00.48 |
| 15 | 47 | 02.42 | 01.67 | 69.01 | 00.09 | 00.93 | 00.89 | 02.26 | 01.59 | 70.35 | 00.11 | 00.97 | 00.86 |
| 16 | 50 | 02.69 | 01.85 | 68.77 | 00.24 | 00.35 | 00.85 | 02.79 | 01.98 | 70.97 | 00.19 | 00.33 | 01.29 |
| 17 | 48 | 02.47 | 01.50 | 60.73 | 00.29 | 00.80 | 00.85 | 02.55 | 01.65 | 64.71 | 00.37 | 00.57 | 01.00 |
| 18 | 35 | 02.53 | 01.64 | 64.82 | 00.22 | 00.89 | 00.67 | 02.59 | 01.31 | 69.88 | 00.67 | 00.57 | 00.92 |
| 19 | 43 | 02.70 | 01.50 | 55.56 | 00.28 | 00.66 | 00.92 | 02.67 | 01.51 | 56.55 | 00.15 | 00.18 | 01.33 |
| 20 | 50 | 02.46 | 01.86 | 75.61 | 01.24 | 01.30 | 00.07 | 02.33 | 01.77 | 75.97 | 00.39 | 01.16 | 00.31 |

## PRE TREATMENT

| | FVC | FEV1 | FEV1/FVC | ERV | IRV | TV |
|---|---|---|---|---|---|---|
| **Mean** | 2.4305 | 1.5095 | 62.386 | 0.423 | 0.758 | 0.634 |
| **SD** | 0.244529 | 0.280422 | 11.46373 | 0.331648 | 0.319961 | 0.428355 |

## POST TREATMENT

| | FVC | FEV1 | FEV1/FVC | ERV | IRV | TV |
|---|---|---|---|---|---|---|
| **Mean** | 2.3015 | 1.4705 | 1.31 | 0.4235 | 0.758 | 0.634 |
| **SD** | 0.262524 | 0.288069 | 11.29259 | 0.430963 | 0.319961 | 0.428355 |